

## Hydrogeophysics

reviewed by Stephen Moysey

The timing is right for the appearance of the book *Hydrogeophysics*, edited by Yoram Rubin and Susan S. Hubbard. Although geophysical methods have been used to complement hydrogeologic studies for many decades, advances in geophysical equipment and imaging techniques over the past 15 years are quickly revolutionizing the way we study ground water flow and transport. The 17 chapters of this book, contributed by more than 30 leading experts, present a timely and much needed compilation of some of the key concepts, methods, experiences, and challenges encountered by researchers in the emerging field of hydrogeophysics.

The book is divided into four sections: (1) Background and Hydrogeology; (2) Fundamentals of Environmental Geophysics; (3) Hydrogeophysical Case Studies; and (4) Hydrogeophysical Frontiers. The first section contains three chapters, each of which is notable. The editors begin the book with a historical retrospective and topical overview of the field of hydrogeophysics. In the second chapter, Jim Butler presents an interesting comparison of hydraulic conductivity measurements that will be of interest to any hydrogeologist; methods discussed range from classical permeameter, slug, and pumping tests to state-of-the-art borehole flowmeter tests and the emerging technique of hydraulic tomography. The third chapter presents an outstanding primer on geostatistics by Jaime Gómez-Hernández. This chapter was an unanticipated treat that provides an excellent summary of common geostatistical methods and issues, introduces the reader to cutting edge techniques (e.g., multiple point geostatistics), and even provides a useful list of Web sites where public domain codes can be obtained.

The second section reviews common geophysical methods used in hydrogeophysical investigations, including electrical resistivity, induced polarization, electromagnetic induction, ground-penetrating radar, seismic methods, borehole logging, and airborne surveying. This section also includes chapters discussing rock physics and the relation between hydrologic and geophysical properties. Chapters in this section strike a good balance between giving readers a broad survey of each topic and providing the details needed to understand the fundamental principles behind the methods. Some readers, however, may be disappointed that

specifics on equipment and survey implementation are not covered.

Case studies at the regional, local, and laboratory scales along with a chapter dedicated to experiences in the vadose zone are presented in the third section of the book. The authors of each chapter present examples in which geophysical techniques are used for both characterization and monitoring studies. The organization of these chapters ranges from describing a few specific studies in detail to providing a broad overview of different studies, leaving the reader to independently look up the details.

Surface nuclear magnetic resonance and magneto-electrical resistance methods are discussed as emerging hydrogeophysical methods in the fourth and final section of the book. Stochastic data integration is also discussed in this section. Surprisingly absent from this discussion of "Hydrogeophysical Frontiers" are the emerging applications of the well-known self-potential method and a discussion of biogeophysics, both of which have been achieving major advances in recent years.

A criticism of *Hydrogeophysics* is the lack of a chapter dedicated to inverse problems similar to the one on geostatistics, since data fitting is central to geophysical imaging problems. Although inversion is discussed briefly in several chapters, an easy-to-read introduction to the basic concepts would have been a great asset. The discussion on stochastic data fusion presented in the final section of the book is useful in this regard but likely will be too advanced for many readers new to these kinds of problems.

*Hydrogeophysics* provides an excellent introduction to the field. The book is a particularly good starting place for researchers who want to get involved in this area of study and need a quick overview (or refresher) to get them oriented. *Hydrogeophysics* will provide these readers with the baseline of knowledge they need to tackle the rapidly evolving literature. This book also is appropriate for upper level undergraduate and graduate level courses, though instructors probably will find themselves supplementing with practical information on field methods and additional details on the case studies. Although this book does not cover the breadth of methods covered by other books on environmental or near-surface geophysics, it is distinguished by its focus on applications in hydrogeology. Given the important role that geophysics is taking on in hydrogeology, *Hydrogeophysics* is likely to receive a prominent position on many bookshelves.

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